Section 6:

6.1 Landfill Gas (LFG) Control System

A variety of technologies are available for controlling landfill gas accumulation and migration. Landfill gas management is designed for two purposes: Extracting gas from the landfill and controlling gas migration. Two basic types of gas collection systems, passive and active, are used depending upon the gas management purpose and rate of gas accumulation and migration. Passive gas systems collect and release LFG at single points that are not connected. Each gas collector is extended at a safe distance above the surface to allow LFG to be vented to the atmosphere. Active extraction systems link together a group of gas collectors with piping.

6.2 Suitability of the System

The suitability of the system depends on gas management objectives (gas removal or gas migration control) and a number of site factors, including:

- Design and age of the landfill
- Type of waste (organic content of waste)
- Waste volume and thickness
- Local conditions (geology, site features, adjacent land use and demographic)

6.3 Function of Gas Control System

- Limit emission of methane and non-methane organic compounds (NMOC) to 25% LEL and 50 Mg./yr., respectively.
- Prevent gas explosions.
- Limit lateral migration of gas.
- Control subsurface LFG migration.

6.4 Passive Control System

Passive control systems rely upon the natural forces of convection and diffusion to control landfill gas migration. Passive systems are installed where gas generation is low and off-site migration of gas is not expected. Essentially passive venting is for small municipal landfills. The system consists of a series of isolated gas vents designed to create preferential pathways for gas migration. Usually one vent per acre is probably sufficient. Some times these isolated vents are connected by a perforated pipe embedded in the grading layer. Figures 7 and 8 illustrate the concept of a passive system.

Figure 7: Passive Gas System Using Gravel and Dirt Trap Trench

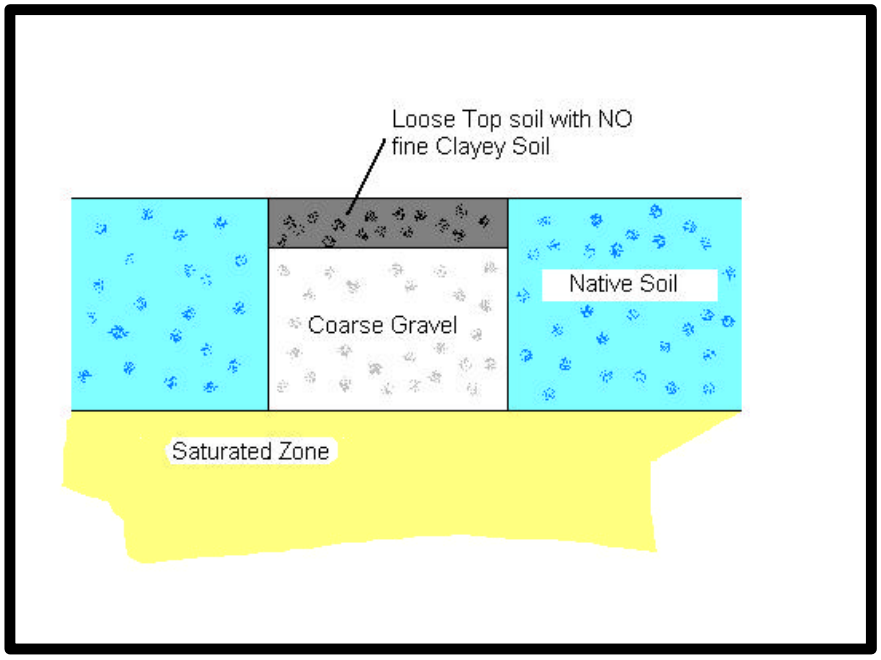
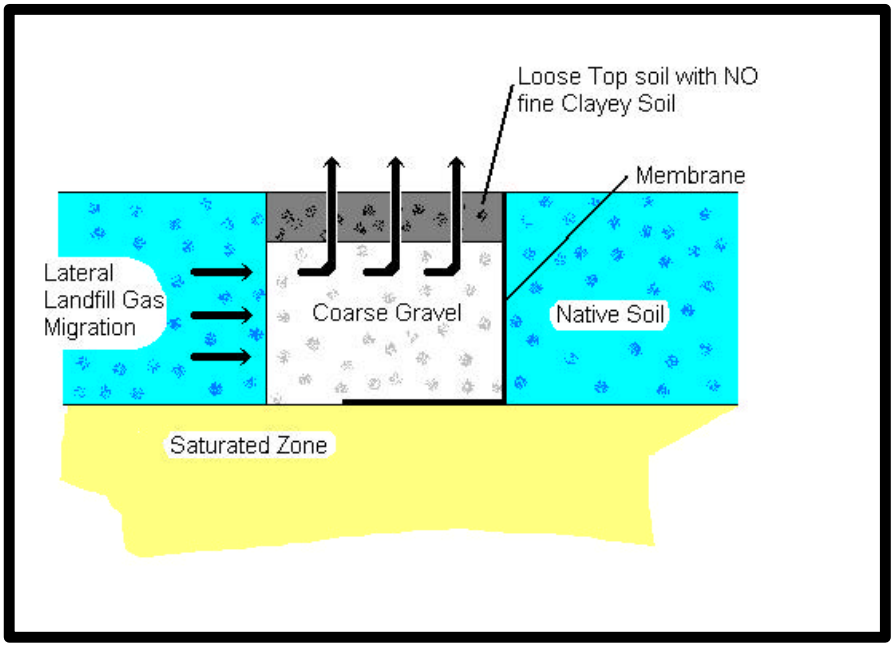


Figure 8: Passive Gas System Using Gravel and Dirt Trap Trench with Membrane On Back Wall



6.5 Active Control System

An active system consists of deep extraction wells connected by a header pipe to a blower that either delivers the gas for energy reuse purposes, or to an on- site burner or simply releases it to the atmosphere. Whether the gas can be released to the atmosphere without burning depends on: (1) Chemical constituents of gas. If hazardous air contaminants such as vinyl chloride or benzene are present, then burning the gas is the preferred option; (2) Location of landfill. If the landfill is located near/within a community, then burning is necessary because methane has an odor of its own that may create a nuisance condition.

The major components of active control system consist of one or more of the following components:

- Gas process piping and valve
- Inlet scrubber vessel or liquid knockout
- Gas compressor or blower
- Check valve
- Flow metering
- Automatic block valve
- Flame arrester
- Flare
- Instrumentation
- Electrical control
- Electrical service
- Condensate handling and treatment equipment
- Facility utilities (LFG, air compressor, sewer, etc.)

Please note a description and operation of above major components of LFG active systems are described in references 1 and 7.

6.6 Methodology

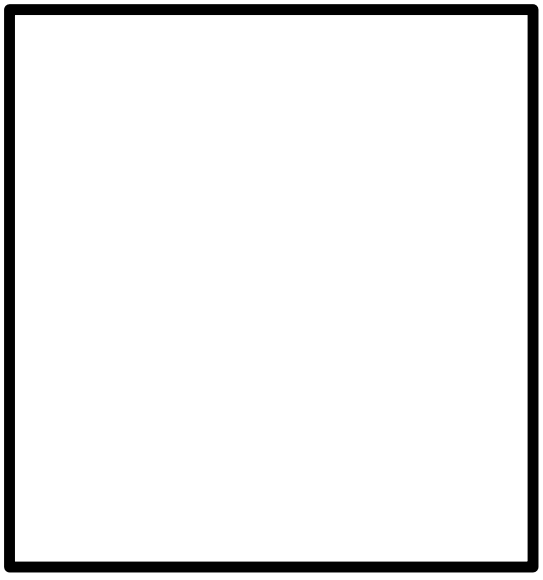
Passive vents can include:

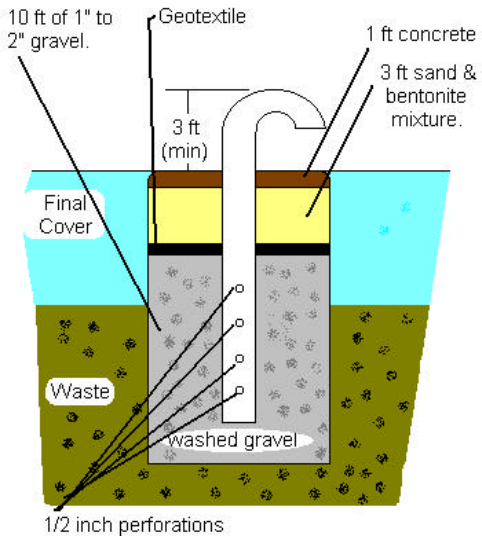
- A simple trench filled with granular backfill, as depicted in Figure 7 acts as a passive system. The depth of the trench must be adequate to intercept migrating gas. The trench extends from the saturated zone to the surface. This type of system is effective only when the gas quantities are small.

- A trench backfilled with gravel and a membrane installed along the back wall of the trench, as depicted in Figure 8 is another passive system, but it represents a more effective interceptor.

- A gravel trench with vertical vent pipes allows easy exhaust to the surface, as shown in Figure 9. The typical diameter, spacing, and stickup (the length above grade of the vent) are as noted.

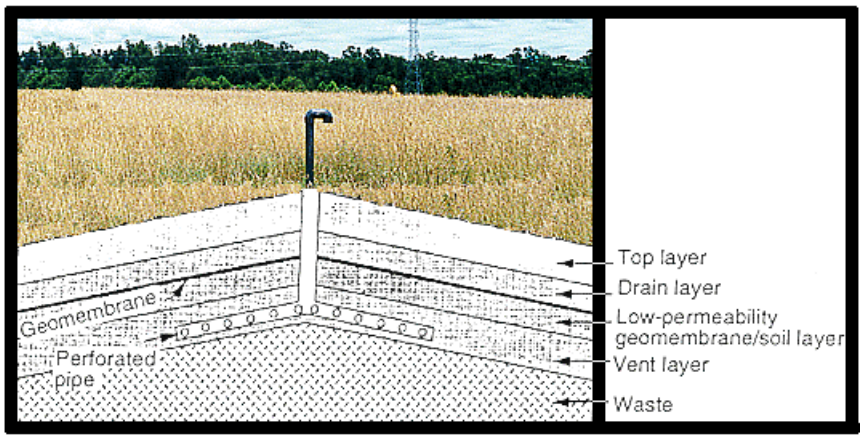
Figure 9: Typical Detail of an Isolated Gas Vent





- A gravel trench with horizontal collector and vertical vent pipes, as shown in Figure 10 provides an easier mechanism or conduit for exhaust to the atmosphere.

Figure 10: Typical Detail of a Passive Gas Venting System with a Header Pipe



Active control systems can include:

- Extracting systems (trench and/or wells). Active gas extraction system may include a series of trenches and/or wells with collection headers for extracting gases from deeper layers within the landfill. Trenches are generally employed as perimeter gas extraction systems or at shallow depths within the landfill while wells are more practical as primary extraction system in thickest portions of the landfill. The well casings and/or piping installed within the trenches are connected to extraction blowers or pumps. Typical active gas extraction wells and trenches are shown in Figures 11 and 12.

- Air injection systems. Injection of air can be used as an active mechanism to restrict lateral migration of landfill gases. Air injection systems are installed in a perpendicular direction to

the gas migration pathway. Air is injected through a header system to create a subsurface pressure gradient which restricts or reverses the direction of gas migration.

Figure 11: Typical Gas Extraction Well

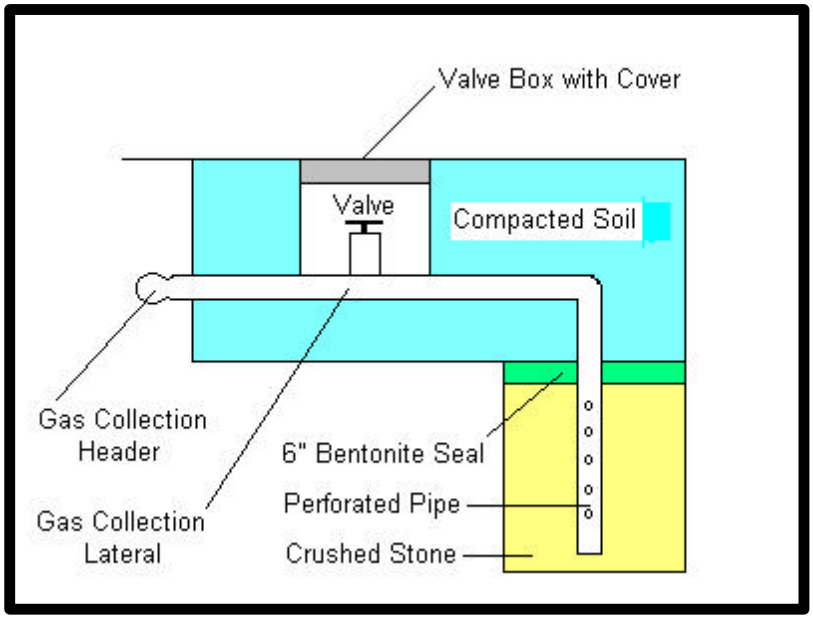
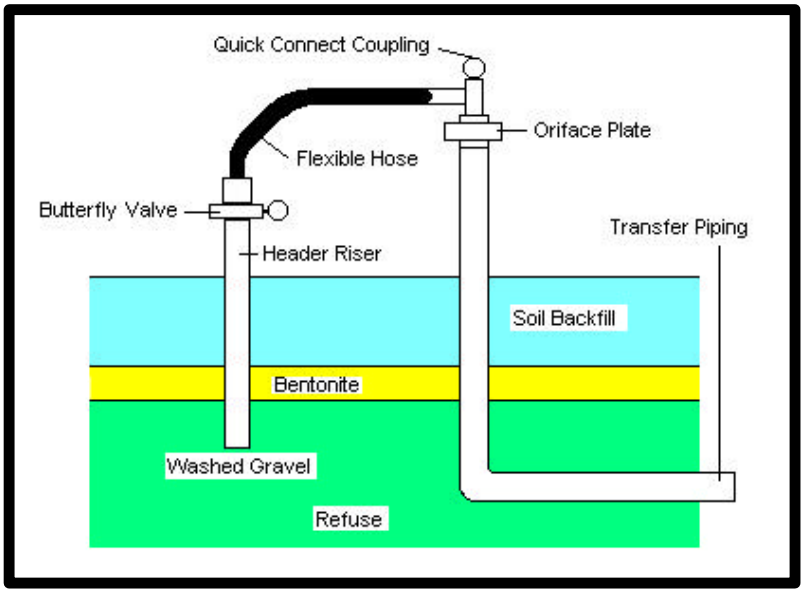


Figure 12: Typical Gas Extraction Trench and Header



6.7 Design Considerations

Passive System

The following guidelines should be considered in designing passive gas systems:

A. Determine if facility must comply with new source performance standard and emissions guidelines.

B. Determine if landfill is in compliance with Title V of the Clean Air Act.

C. Demonstrate adequacy of landfill gas management system based on a landfill gas prediction model.

D. Penetration of final cap

E. Location of pipe system

F. Detail of pipe system

G. Allow methane generated within landfill to vent through the impermeable cover. Typically one vent per acre is installed. Additional vents are installed if exhaust from vents exceed 25% LEL.

H. The number of vertical risers through the cover should be minimized and located at high points in the cross section and designed to prevent water infiltration through and around them.

I. Landfill gas collection/venting systems should be installed prior to construction of the barrier layer so as to inhibit off-site migration of landfill gas.

J. Long-term maintenance/protection (post closure care).

Active System

Several critical issues are involved in designing and developing an active LFG system. Design and developing of such system are beyond the scope of this guidance document. However, special emphasis to reference No. 1 and No. 2 from the list of Bibliography/References provide excellent sources for design and developing an active system.